Diverticular Disease of the Colon

Learning Objectives

- **Recognize general findings related to incidence of diverticular disease and dietary intake.**
- **Determine colon characteristics of patients with diverticular disease and related histology findings.**
- **Identify how fiber prevents segmentation and colonic intraluminal pressure.**

Learning Objectives

- **Identify signs and symptoms of uncomplicated symptomatic disease.**
- **Identify signs, symptoms, and treatment for diverticular hemorrhage.**

Learning Objectives

- **Identify signs, symptoms, physical exam findings, and diagnostic tests for conditions related to diverticulitis.**
- **Identify treatment and prevention courses for diverticular disease of the colon.**

Diverticular Disease of the Colon

- **Historical perspective:**
  - **First described by Cruveilhier in 1846**
  - **Letter in Lancet credited Sir Erasmus Wilson for his specimen description in 1840:**

“Projecting from sides of the colon, in intervals of the septa, were small coecal pouches, in each was situated one of the concretions referred to. The number of pouches and concretions amounted to nearly thirty.” **taken from *CJS*, June 1991**

Diverticular Disease of the Colon

Outline

- **Epidemiology**
- **Dietary Issues**
- **Anatomy/Histology**
- **Etiology/Pathogenesis**
- **Symptoms**
- **Complications/Natural History**
- **Prevention/Treatment**

Epidemiology

- **Pre-20th century: “Peculiar finding”**
- **Since 1900, found in large proportion of U.S. population**
- **Disease of Western civilization/ industrialized nations consuming a “Western diet”**
- **Higher prevalence in U.S., Europe, Australia**

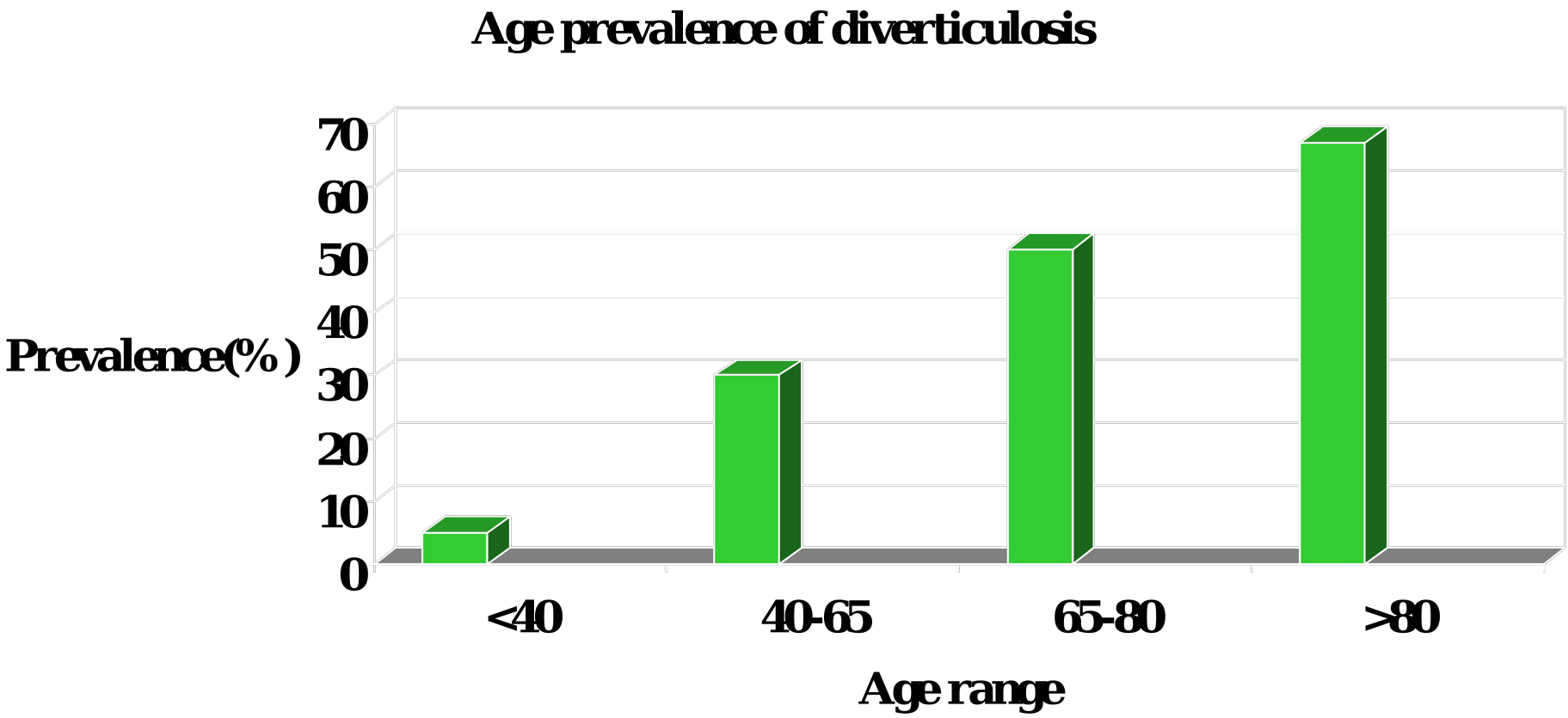
Epidemiology

- **Less common in Africa, Asia, South America**
- **Disease of elderly people**
- **Welch, et al (*Ann Surg, 1953*) found diverticula in 2/3 of patients > 85 using barium enema exams**
- **Rare before age 40**

Epidemiology

- **More aggressive course if starts at younger age**
  - **More troublesome symptoms**
  - **Higher complication rate**

Diverticular Disease of the Colon
Epidemiology



Epidemiology

- **Sex predilection**
  - **Early 1900's - reported gender ratio was M:F of 2:1**
  - **Mid to late 1900's - ≥ female predominance**

Epidemiology

- **Cost implications:**
  - **Complicated disease yields:**
    - **200,000 hospitalizations annually in U.S.**
    - **$750 million in healthcare spent per year**

Dietary Issues

Painter & Burkitt adopted theory of reduced dietary fiber as a cause of increased incidence of diverticulosis since 1920

Dietary Issues

- **Noted these dietary changes in late 1800's:**
  - **Improved milling methods extracted $^{2}/_{3}$ of fiber from flour**
  - **Intake of refined sugar, meat doubled between 1860-1890, were accompanied by fall in consumption of bread**

Dietary Issues

- **Fiber-deficiency hypothesis is supported by:**
  - **Increased diverticular disease trends in:**
    - **U.S. negroes compared to African negroes**
    - **Japanese born, bred in Hawaii compared to Japan**
    - **Animal studies employing high fiber diets**

Dietary Issues

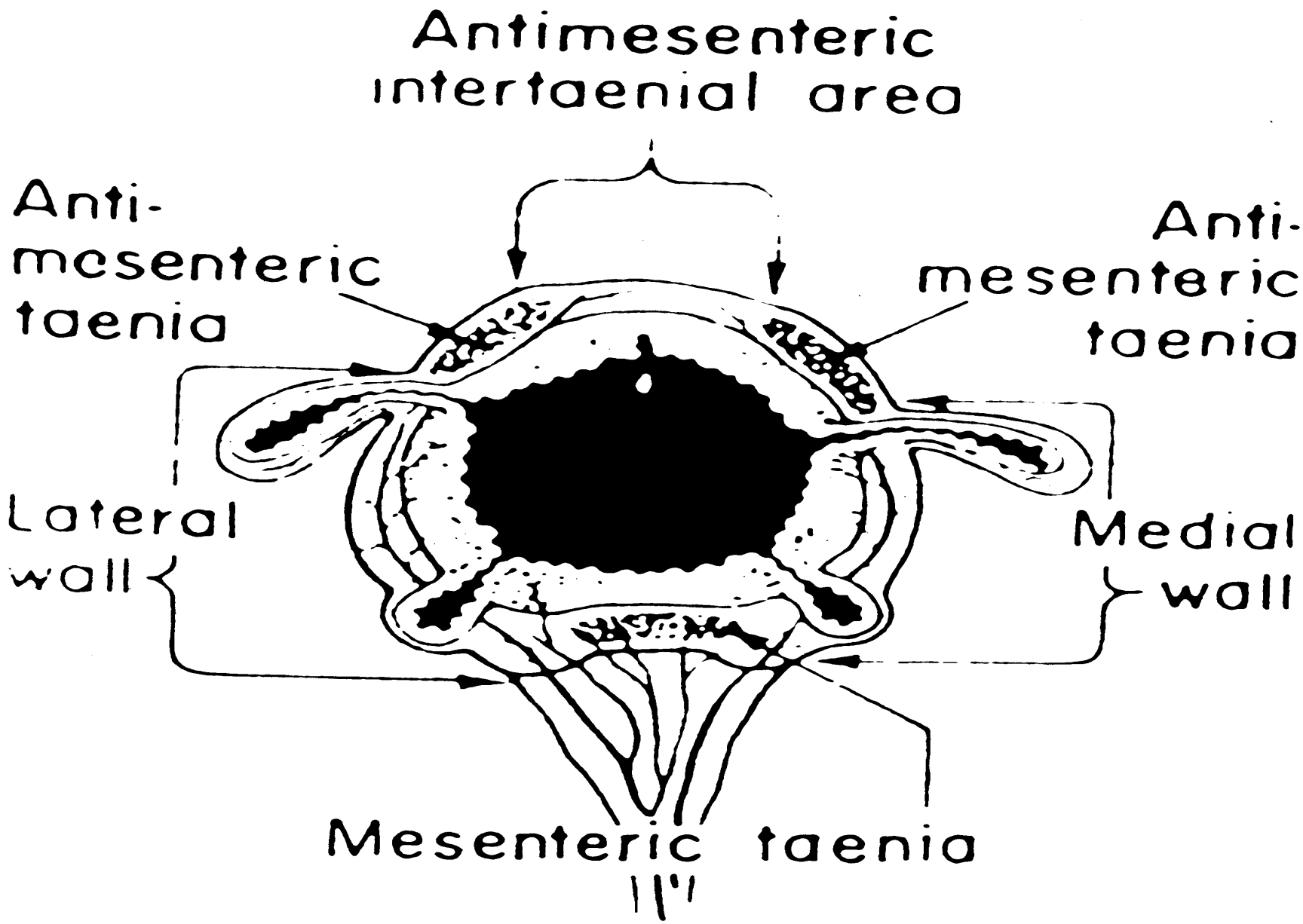
- **Decreased diverticulosis and diverticulitis in:**
  - **Vegetarians compared to non-vegetarians**
  - **Animal studies employing high fiber diets**

Anatomy

- **Diverticulosis is a misnomer since traditional diverticula are actually “pseudodiverticula”**

Anatomy

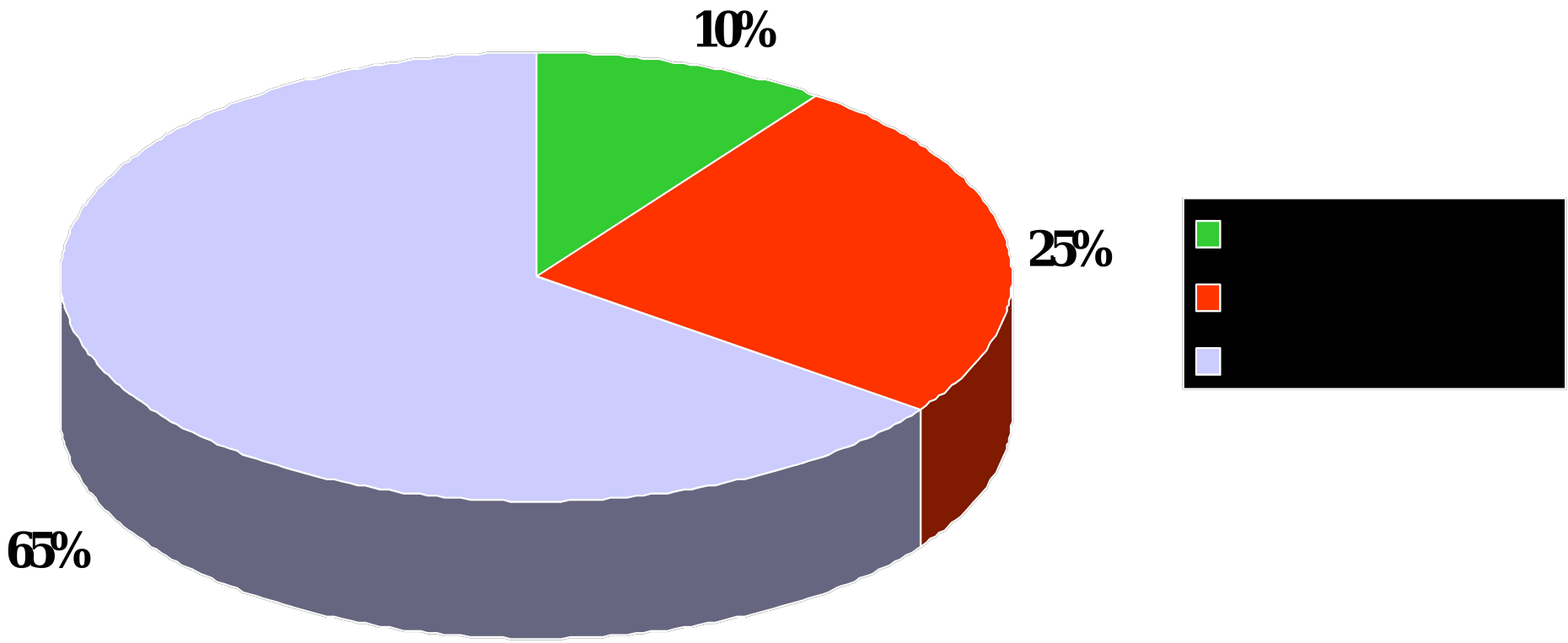
- **Characterized by:**
  - **Mucosal herniations through circular muscle layer**
  - **Location along one of four rows between mesenteric and anti-mesenteric teniae**
  - **Occur at penetration points of vasa recta as they traverse muscular layer to submucosa**


Antimesenteric
intertaenial area
Anti-
mesenteric
taenia
Anti-
mesenteric
taenia
Lateral
wall
Medial
wall
Mesenteric taenia

Diverticular Disease of the Colon

Anatomy

Anatomic regionality of diverticula in U.S.



Anatomy

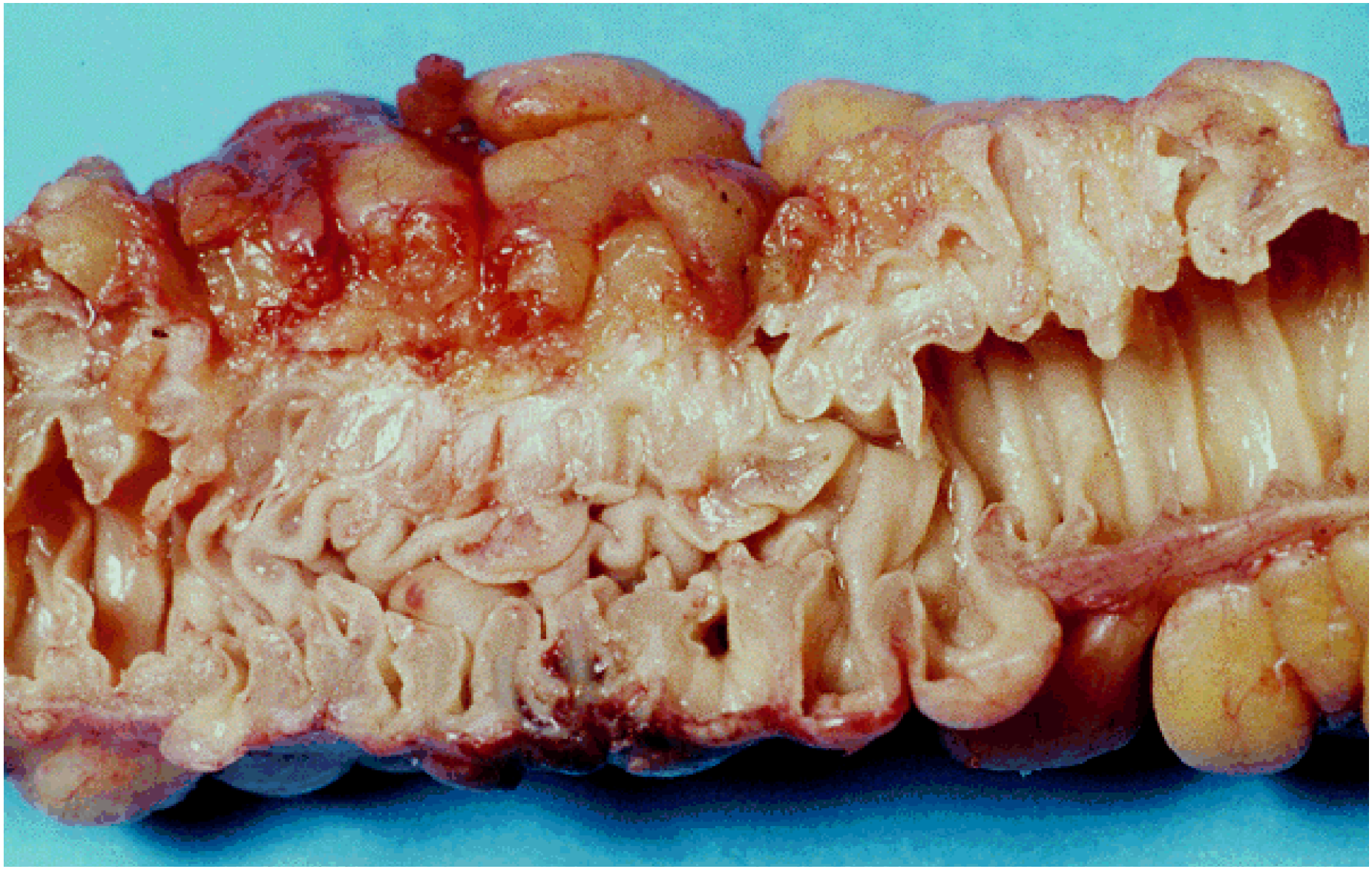
- **Typical anatomical features of sigmoid disease:**
  - **Thickened teniae with cartilaginous consistency**
  - **Thickened circular muscle with concertina appearance**

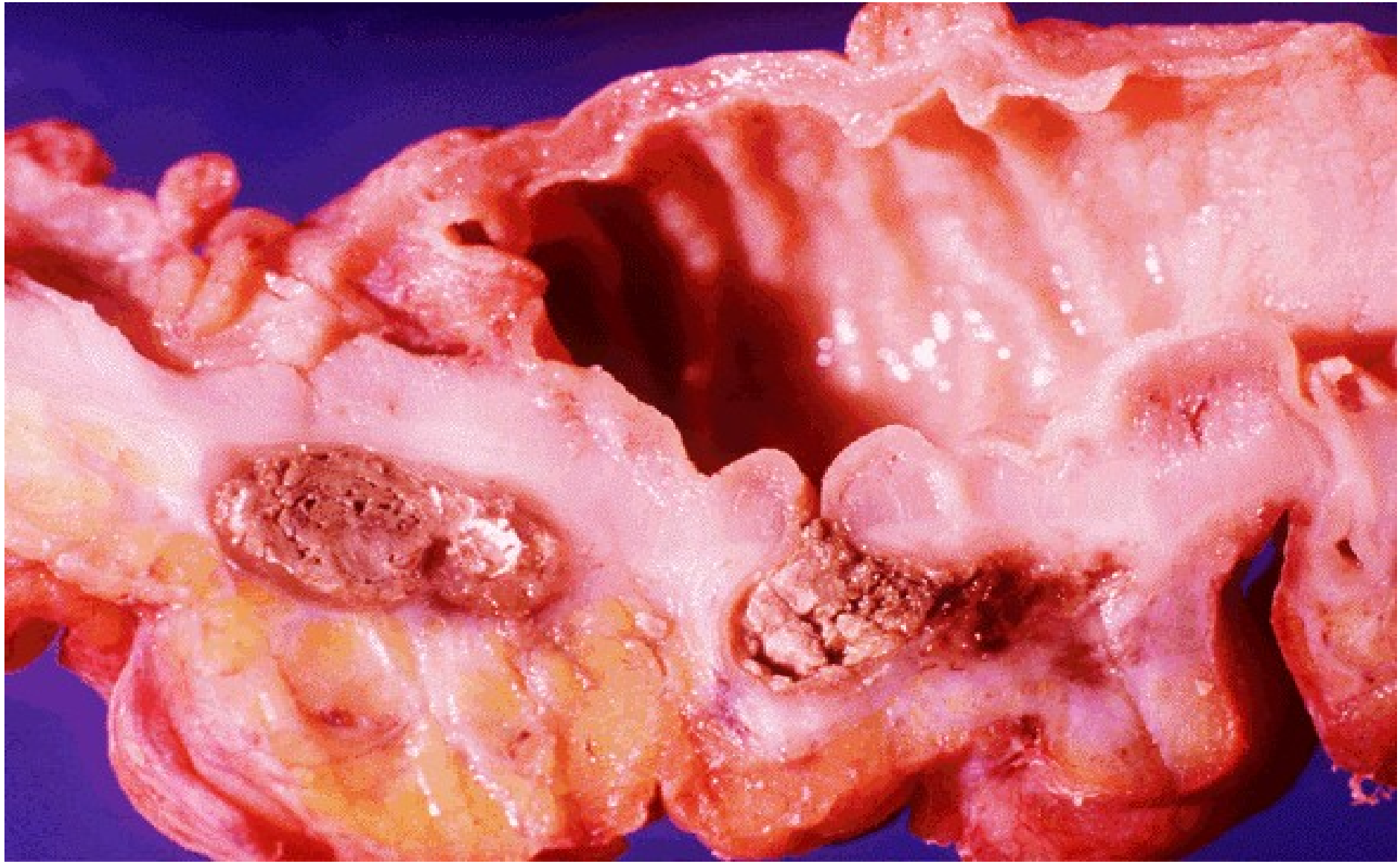
Anatomy

- **Reduced luminal diameter**
- **Marked redundancy of mucosa with shortening**
- **Increase in pericolic fat**

Anatomy

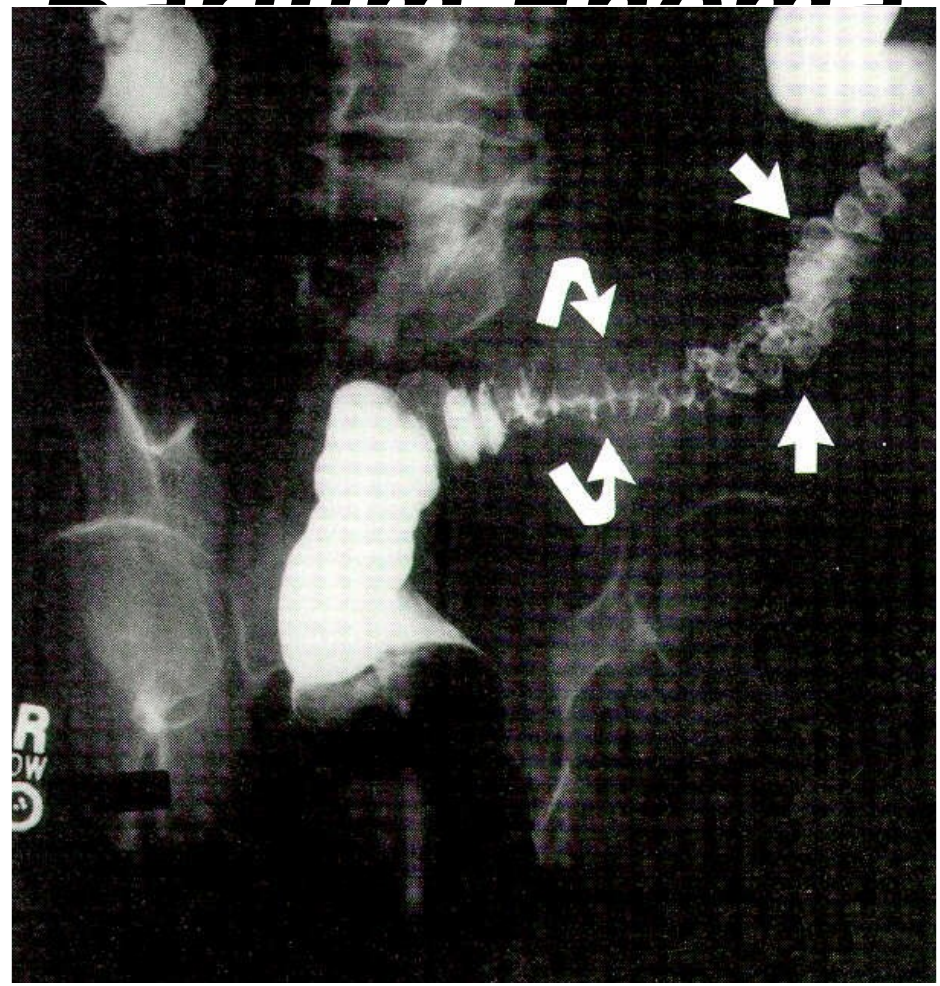
- **Thickening and shortening of colon is not as evident in right-sided disease**
- **Excess fibrosis and rigidity may be seen in severe disease and usually indicates past episodes of diverticulitis**





Diverticular Disease of the Colon

Barium Enema

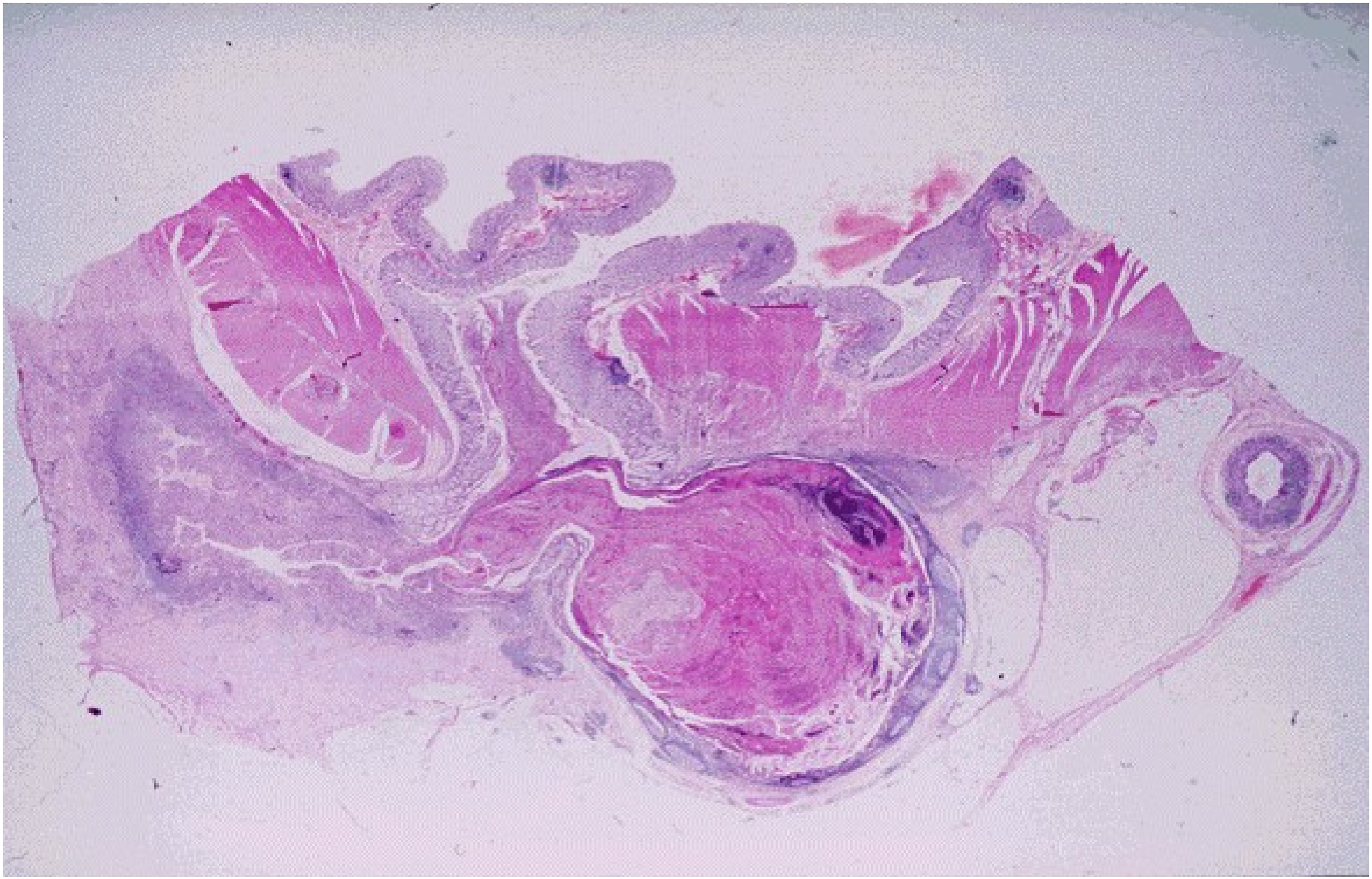


Histology / Ultrastructure

- **Muscle layers thickened w/o hypertrophy, hyperplasia**
- **Circular muscle fasciculi are narrowed, attenuated**

Histology / Ultrastructure

- **Teniae have increased *elastin* fibers- may explain contracture lengthwise w/ corrugation of circular muscle fasciculi (*Whiteway, et al., Clin Gastroenterol, 1985*)**
- **Submucosal collagen fibrils: smaller, tightly packed compared to normals, show evidence of increased cross-linking (*Thomson, et al, 1987; Wess, et al, 1995)***



Etiology / Pathogenesis

- **Luminal narrowing, segmental shortening of the sigmoid has been called *myochosis***
- **This is accepted as a pre-diverticular state**
- **Mechanism of progression from this is unclear**

Etiology / Pathogenesis

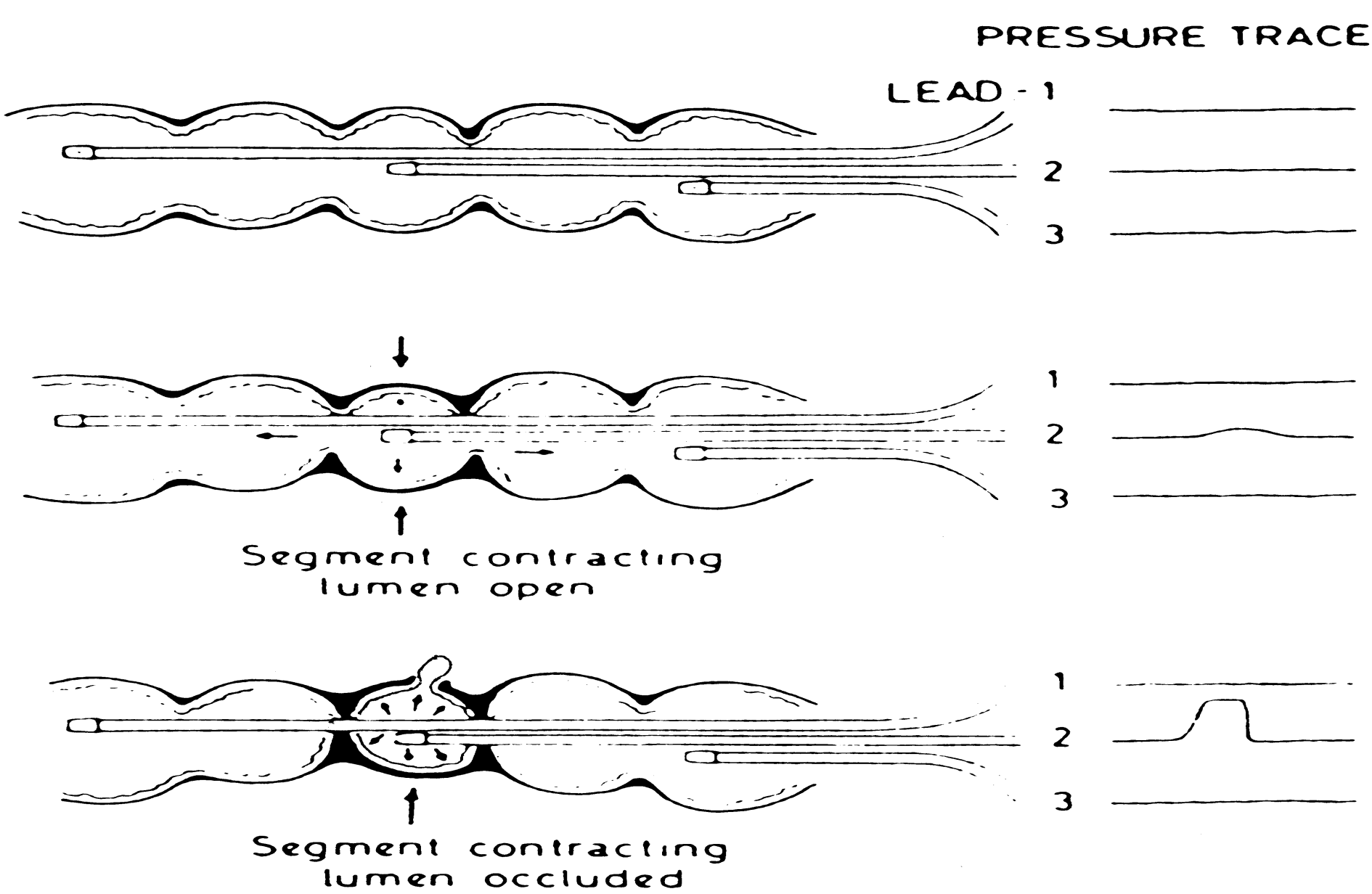
In 1960’s, Painter proposed theory of segmentation of sigmoid colon into “little bladders” which experience high intraluminal pressure and cause herniation at weak points

Etiology / Pathogenesis

- **Segmentation theory supported by colonic manometry, cineradiography studies by Painter/Connell**
- **Found no difference in basal resting pressures of normal, diverticular colons**

Etiology / Pathogenesis

- **Sigmoid segments: intraluminal pressures > 90 mmHg after pharmacologic stimulation of motility**
- **Cineradiography showed transmittal of pressures to diverticula - "blowing them up like balloons"**


PRESSURE TRACE
LEAD - 1
2
3
1
2
3
Segment contracting
lumen open
1
2
3
Segment contracting
lumen occluded

Etiology / Pathogenesis

Barling wrote his observations of a vigorously contracting ‘prediverticular’ sigmoid colon during laparotomy:

Etiology / Pathogenesis

“at one point the bowel suddenly narrowed to half its previous diameter . . . For three or four inches, the bowel becoming the size of the index finger and quite as firm. . . While the spasm lasted, many tiny saccules appeared between the longitudinal bands . . .

Etiology / Pathogenesis

And lay regularly like beads along the sides of the gut. In a few seconds the spasm passed off and a nearly normal bowel remained with faint evidence of the tiny projections indicated for a few seconds by the altered blood supply at those sites owing to the tension to which the peritoneum has been subjected...

Etiology / Pathogenesis

…The cycle of spasm repeated itself thrice during the time the abdomen was open”

Etiology / Pathogenesis

How does fiber prevent segmentation and high colonic intraluminal pressures?

Fiber

- **Increases stool weight**
- **Increases colonic luminal diameter**
- **Lowers colonic pressures**
- **Improves transit time**

Etiology / Pathogenesis

- **Less well-studied theory for the development of high intraluminal pressures suggests the presence of *spasmogen* (? Bile acids)**
- **Hypothesized that fiber along with absorbed water may dilute the effect of some irritant agent in the stool**

Uncomplicated Symptomatic Disease

- **80-85% of pts with diverticulosis are either asymptomatic or have mild complaints for which they seek no medical attention**
- **Remainder present with pain or with symptoms related to complications (bleeding, infection, obstruction)**

Uncomplicated Symptomatic Disease

- **Resembles IBS:**
  - **Episodic LLQ abd pain improved by passage of flatus or stool**
  - **Alteration in bowel habit**
  - **Sense of incomplete evacuation**
  - **Excessive flatulence**
  - **Narrow or hard, pellet-like stools**

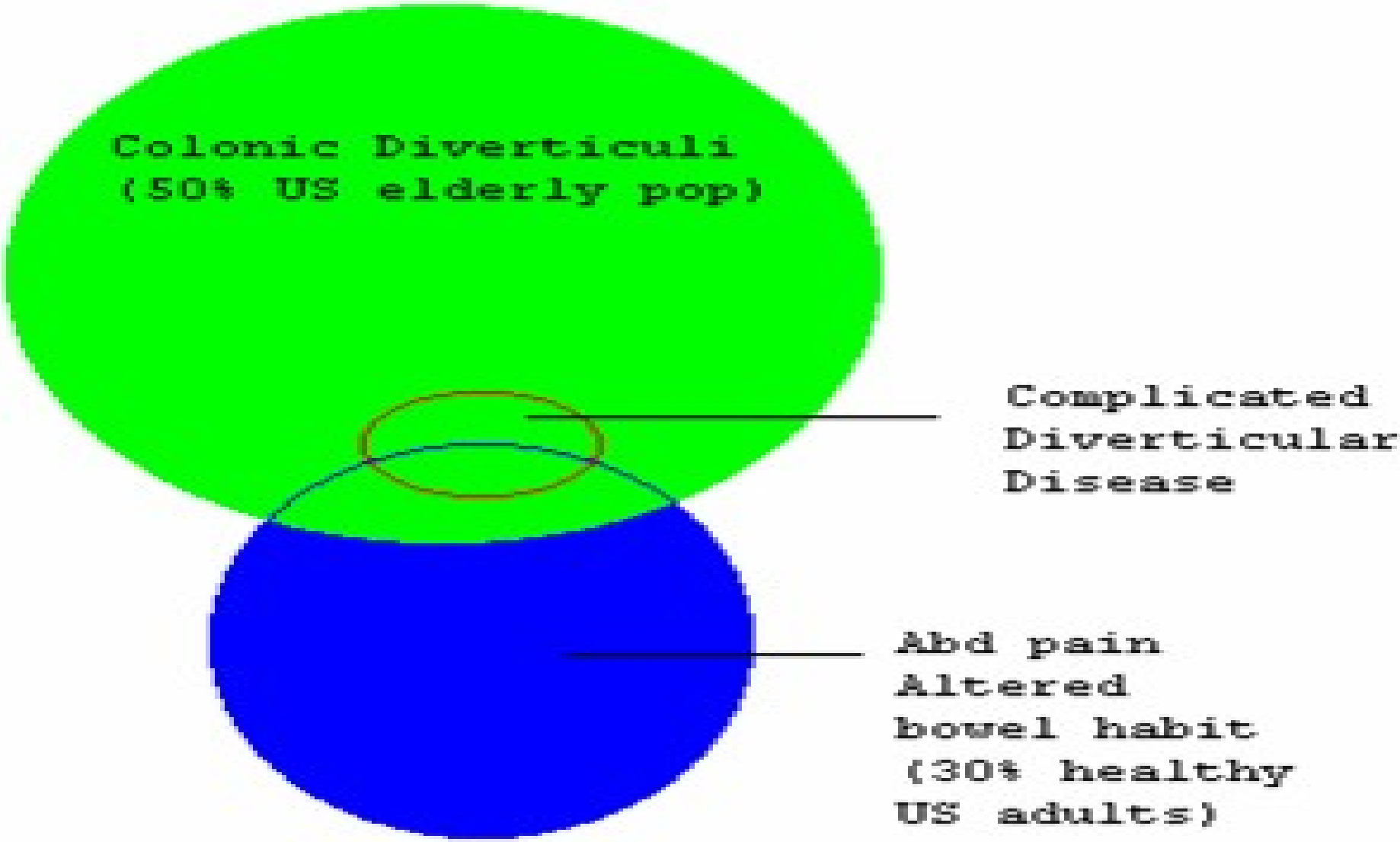
Uncomplicated Symptomatic Disease

Is IBS a pre-diverticular state?

- **1958 Horner study found 83% of pts (n=42) labeled as ‘IBS’ developed diverticulosis**
- **In subsequent studies, no association found**

Uncomplicated Symptomatic Disease

- **Otte (*Am J Gastro, 1986*) 69 pts with IBS had ACBE: 19/69 with tics, 50/69 without tics**
  - **no significant symptomatic difference found between both groups**



Adapted from Thompson, et al. *Clin Gastroenterol*, 10/86

Uncomplicated Symptomatic Disease

- **Red flags:**
  - **New abdominal pain: need to consider other common entities in this patient population**
    - **Complicated disease (diverticulitis / obstruction)**
    - **Colorectal cancer**

Uncomplicated Symptomatic Disease

- **Minor rectal bleeding -- 5% of pts with diverticulosis will have massive bleeding, another 5-20% may have minor bleeding**

Uncomplicated Symptomatic Disease

- **Red flags:**
  - **Since colorectal cancer and AVM's are the most common 'other' causes in this age group, colonoscopy should be performed**
  - **Barium enema is frequently non-diagnostic due to redundancy of sigmoid colon**

Right-Sided Disease

- **Not as well studied as left sided disease**
- **More common in Orient / Asians**
  - **Postmortem series in Singapore by Lee (*Dis Colon Rectum*, 1986, n=1014) found incidence of 20% (< 10% in US)**
- **Wong, et al. studied complication patterns and outcomes in 180 pts in Singapore**

Singapore study of right and left sided diverticulosis

180 pts with tic complications
42 both sides
76 right sided only
62 left sided only

85 (47%)
Massive rectal bleeding

95 (53%)
Diverticulitis

42 (50%)
Right

14 (17%)
Left

29 (33%)
Both

34 (36%)
Right

48 (51%)
Left

13 (13%)
Both

Diverticular Disease of the Colon

- **Complications:**
  - **Diverticular hemorrhage**
  - **Diverticulitis**
    - **Peridiverticulitis / Intra-abdominal abscess**
    - **Fistulae**
    - **Peritonitis**

Diverticular Bleeding

- **Diverticular bleeding: most common cause of lower GI hemorrhage in elderly patients (~ 40% of cases)**
- **Typically occurs in asymptomatic patients or those without prior diagnosis of diverticulosis**

Diverticular Bleeding

- **15-20% of diverticulosis patients develop bleeding during course of disease, 5% massive**
- **In 60-70% of cases of diverticular bleeding, origin is from right side**

Diverticular Bleeding - Natural History

- **75-80% stop bleeding spontaneously**
- **Estimated 20-30% may develop recurrent bleeding after 1 episode**
- **75-80% of 2nd episodes also stop spontaneously**

Diverticular Bleeding - Natural History

- **Recurrence risk increases to 50% after 2nd episode**
- **Mortality from bleeding: elective colonic resection < 3%, emergent colonic resection > 10%**

Diverticular Bleeding

Differential diagnosis in this age group:

- **Diverticular bleed**
- **Arteriovenous malformation**
- **Ischemic colitis**
- **Colorectal cancer**

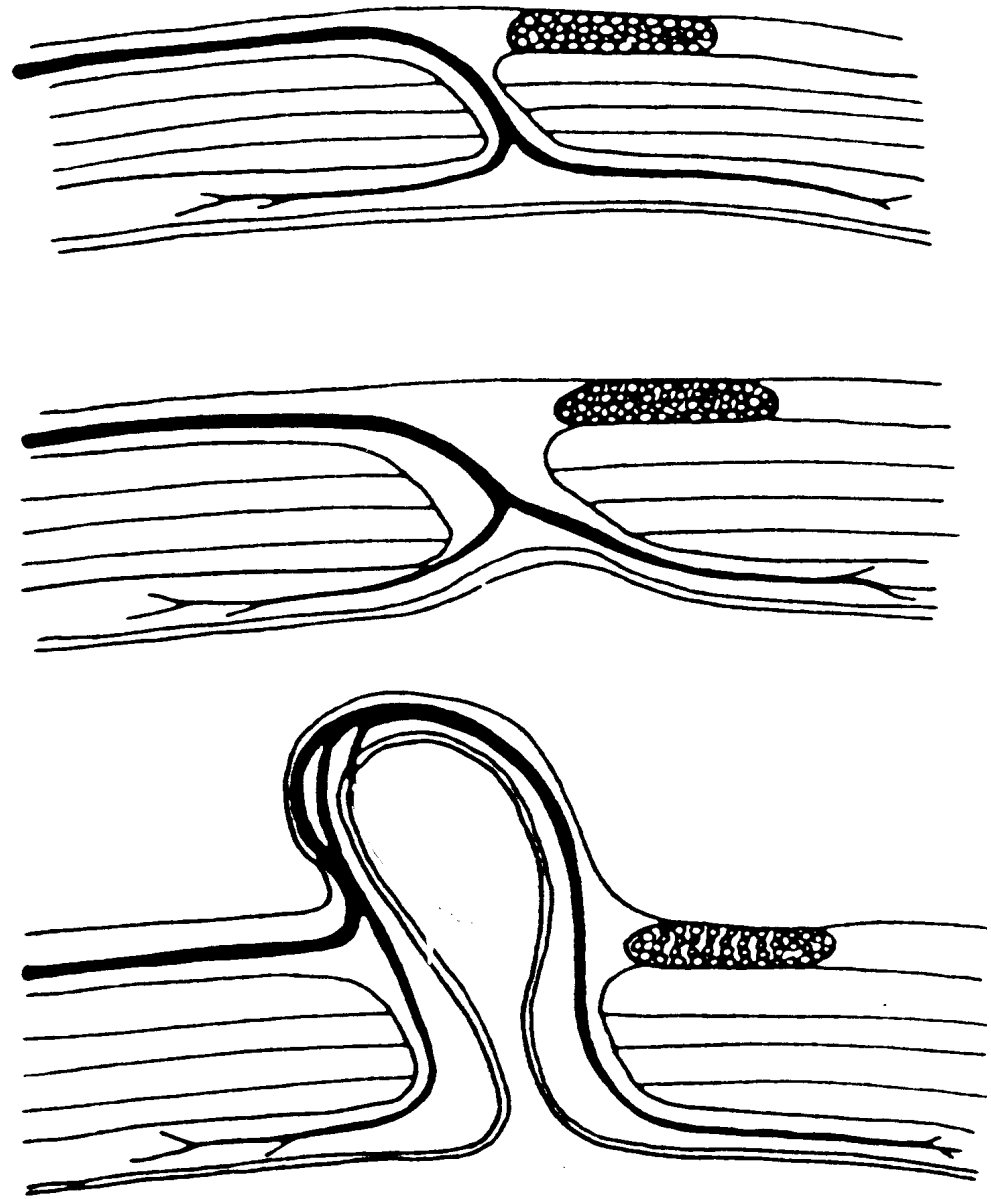
Bleeding Diverticulum

Diverticular Bleeding - Anatomy

- **Gross observations:**
  - **Culprit artery usually located at dome of diverticulum**
  - **Mucosal disruption focal, limited to rupture site**

Diverticular Bleeding - Anatomy

- **Artery ruptures asymmetrically into diverticulum rather than into peritoneal cavity**
- **Suggests mechanical injury from luminal side causes vessel wall damage**



Diverticular Bleeding - Histology

- **Histologic changes:**
  - **Rupture of underlying vasa recta *without* significant inflammatory component**
  - **Eccentric fibromuscular intimal thickening with associated thinning of media**

Diverticular Bleeding - Histology

- **Histologic changes (cont’):**
  - **Similar changes in branches of vasa recta adjacent to bleeding site**

Diverticular Bleeding

Why do right sided diverticula have higher propensity to bleed?

Proposed hypothesis:

- **Wider necks and domes**
- **Vasa recta are exposed over greater length**

Diverticular Bleeding

Treatment modalities:

- **Angiographic: Intra-arterial vasopressin and selective arterial embolization**
- **Surgical**
  - **Targeted partial colectomy with primary anastamosis**
  - **Subtotal colectomy if bleeding site not well defined**

Diverticular Bleeding

- **Endoscopic treatment options (anecdotal data):**
  - **Heater probe**
  - **Epinephrine injection**
  - **BICAP / Gold probe**
  - **Hemoclips**
- **No controlled or head-to-head trials comparing these treatments**

Diverticular Bleeding

Endoscopic treatments - recent published data:

Author	Journal/Yr	Method	N	Success
Bertoni	*Endoscopy*/1990	Epi injxn	1	1/1
Ramirez	*GI Endo*/1996	Epi injxn	4	4/4
Savides	*GI Endo*/1994	Gold probe	3	3/3
Fouch	*Am J Gastro*/1996	Gold probe	4	3/4
Yoshikane	*Endoscopy*/1997	Hemoclips	1	1/1
Hokama	*Am J Gastro*/1997	Hemoclips	3	3/3

Diverticulitis

- **Occurs in 10-20% of patients with diverticulosis**
- **Typically does not develop in those who have had diverticular hemorrhage**
- **Incidence increases with duration of disease**

Diverticulitis

- **Sigmoid colon involved in 90% of cases**
- **2-5% occur at age < 40; follows aggressive course in young with 80-90% requiring surgery**

Diverticulitis - Pathogenesis

- **Results from inspissated fecal matter within a diverticulum**
- **Local abrasion causes chronic inflammation which leads to:**
  - **Microperforation >> Peridiverticulitis, phlegmon**
  - **Macroperforation >> Peritonitis, pericolic abscess, fistula**

Diverticulitis - Clinical Picture

SYMPTOMS

LLQ pain

Nausea, vomiting, malaise

Altered bowel habit

Dysuria, pneumaturia, fecaluria

Feculent vaginal discharge

Flatus vaginalis

SIGNS

Fever

Leukocytes

Diverticulitis - Clinical Picture

EXAM

Abdominal tenderness

Palpable mass

Abdominal rigidity

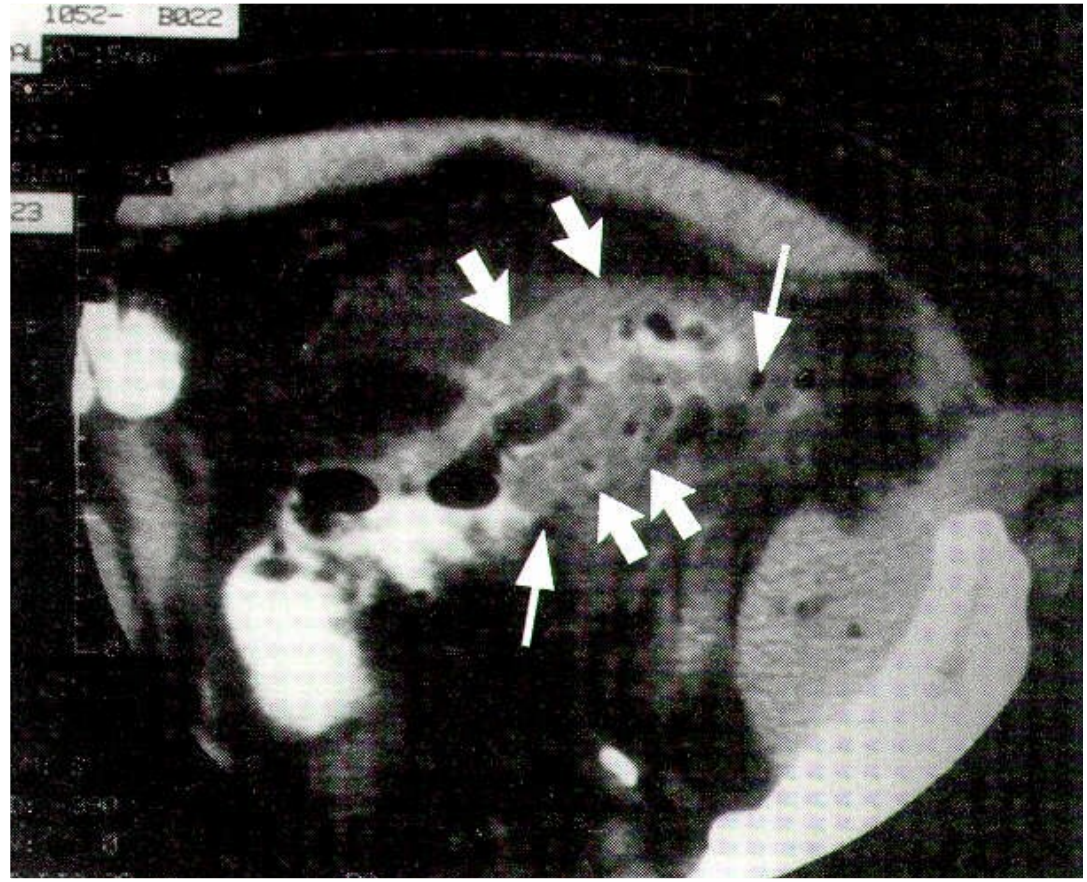
Diverticulitis - CT Imaging

- **Features suggesting diverticulitis on CT scan:**
  - **Focal colonic wall thickening**
  - **Pericolic fat stranding**
  - **Extravasation of contrast**
  - **Phlegmon / Abscess**

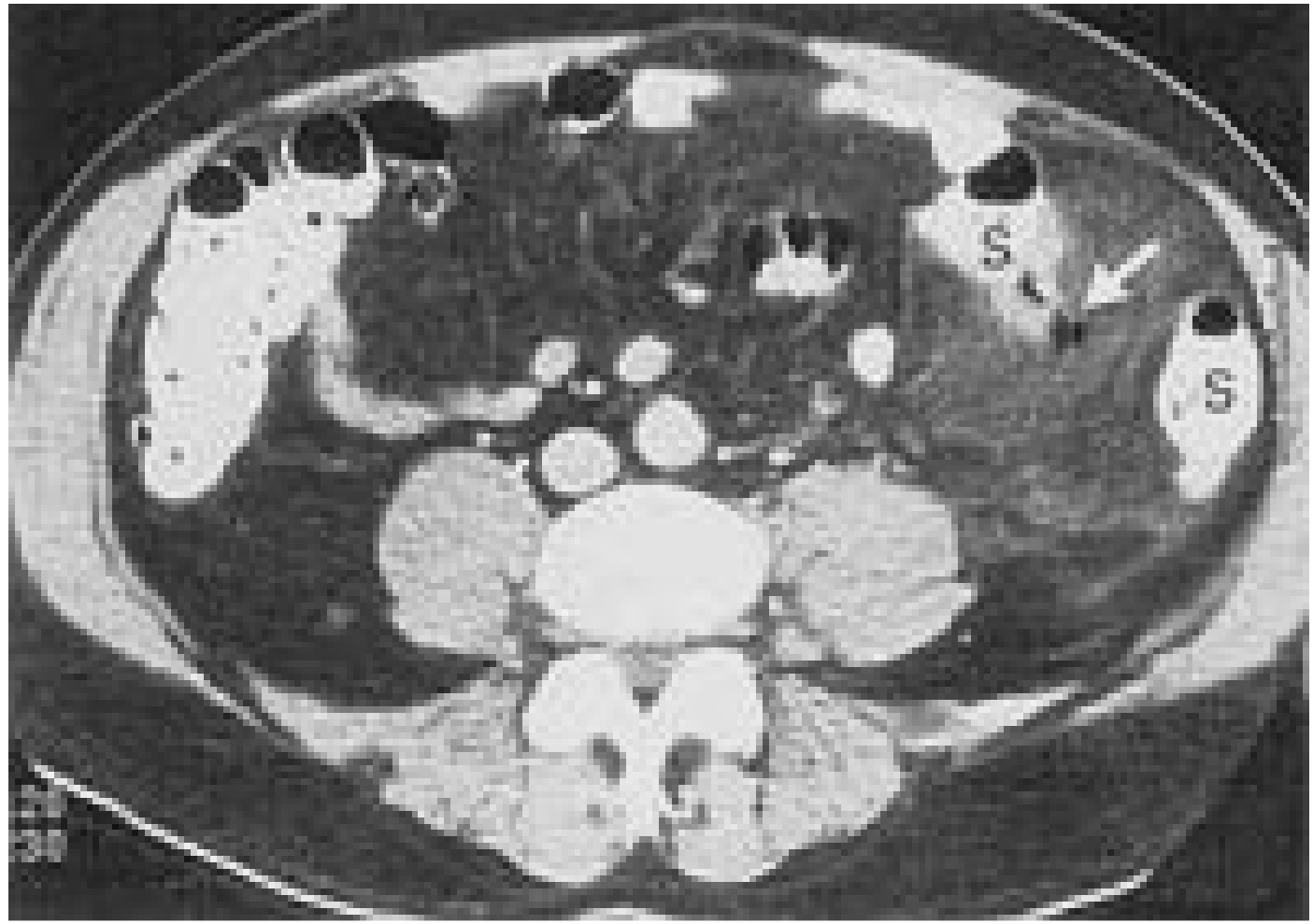
Diverticulitis - CT Imaging

- **Reliable determination depends on adequate luminal opacification and distension**
  - **Aided by contrast enema prior to imaging**

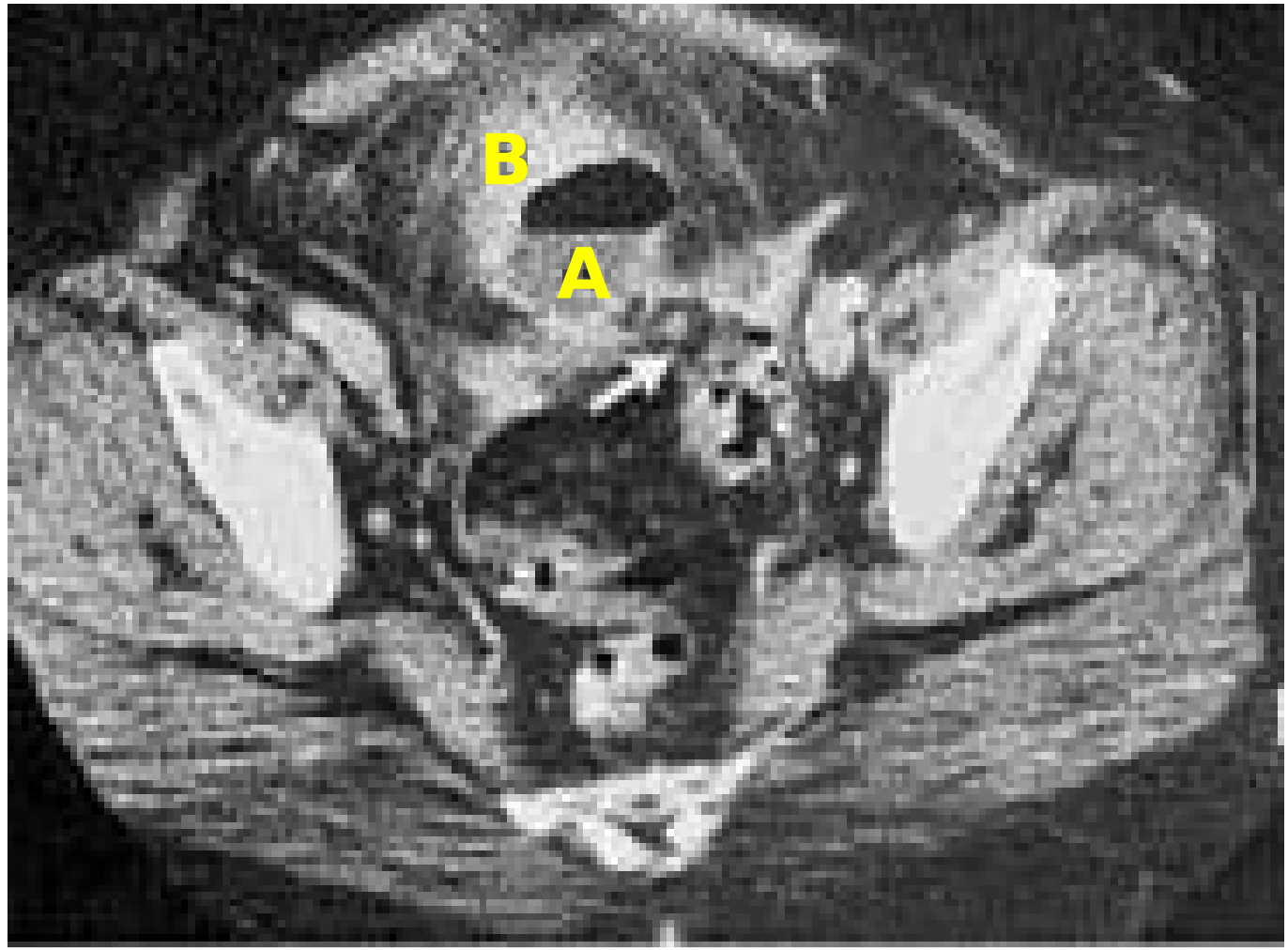
Diverticulitis - CT Imaging



Diverticulitis - CT Imaging



Diverticulitis - CT Imaging



Diverticulitis - Fistulae

- **Colovesical variety is most common: complicates 2-4% of cases of diverticulitis, seen almost exclusively in men**
- **Colovaginal fistulae occur almost exclusively in women who have had hysterectomy (80%)**

Diverticulitis - Fistulae

- **Colo-enteral, colo-uterine and colo-cutaneous fistulae may also develop**
- **Typically diagnosed by contrast enema, oral charcoal, or abdominal CT**

Diverticulitis - Abscess

- **Consider abscess as a complication of diverticulitis if:**
  - **Palpable mass on exam with localized peritoneal signs**
  - **Failed response to medical therapy after 24-48 hrs**

Diverticulitis - Abscess

- **Two types of abscess: localized pericolic, pelvic**
- **Diagnosed by abdominal CT scan**

Diverticulitis - Peritonitis

- Two types: Purulent, Feculent
- Purulent peritonitis
  - rupture of localized pericolic abscess
  - associated with 6% mortality

Diverticulitis - Peritonitis

- **Feculent peritonitis**
  - **least common complication of diverticulitis**
  - **free rupture and spillage of fecal material**
  - **carries 35% mortality**

Diverticulitis - Treatment

- **Mild uncomplicated disease: clear liquids and broad spectrum oral antibiotic therapy, e.g. Quinolone [generic] + Flagyl® for 7-10 days**

Diverticulitis - Treatment

- **Severe uncomplicated disease: Bowel rest and IV antibiotics (e.g. Cefoxitin [generic]) until improved, then discharge on oral regimen**
- *** 25-30% of patients will develop recurrence within 5 years of initial attack**

Diverticulitis - Treatment

- **Recurrent uncomplicated diverticulitis:**
  - **Response to medical therapy less likely with each recurrent episode**
    - **70% chance of response after 1st attack**
    - **6% chance of response after 3rd attack**

Diverticulitis - Treatment

- **Recurrent uncomplicated diverticulitis:**
  - **Response to medical therapy less likely with each recurrent episode**
    - **70% chance of response after 1st attack**
    - **6% chance of response after 3rd attack**

Diverticulitis - Treatment

- **Resection recommended after two bouts**
- **Aggressive nature in younger pts (< 40-50) prompts resection after 1 bout of diverticulitis**

Diverticulitis - Treatment

- **Complicated disease:**
  - **Fistulae: elective primary resection and anastamosis**
  - **Abscess: percutaneous drainage with early or delayed primary resection and anastamosis**

Diverticulitis - Treatment

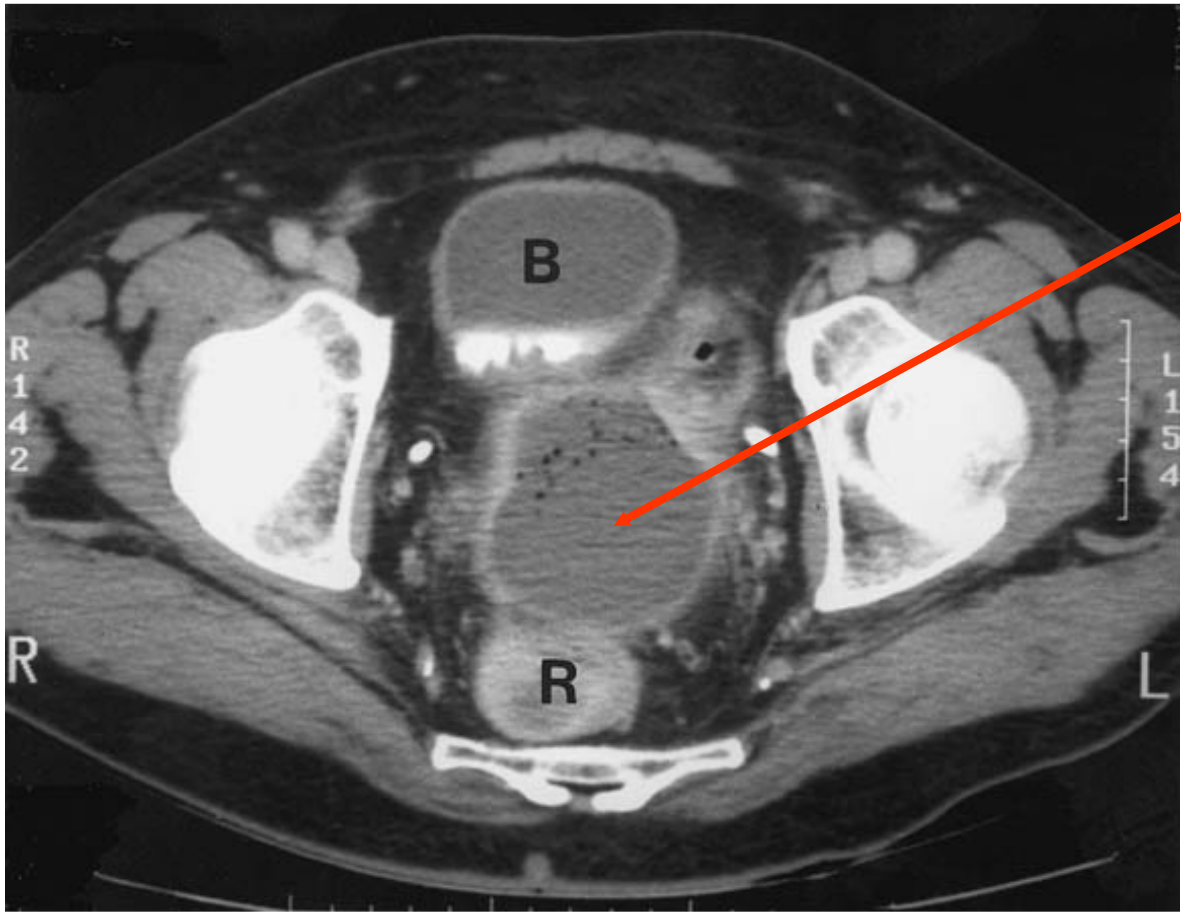
- **Complicated disease (cont’):**
  - **Peritonitis: Hartmann’s procedure (resection with sigmoid colostomy and closure of rectal stump)**

Diverticulitis - Treatment

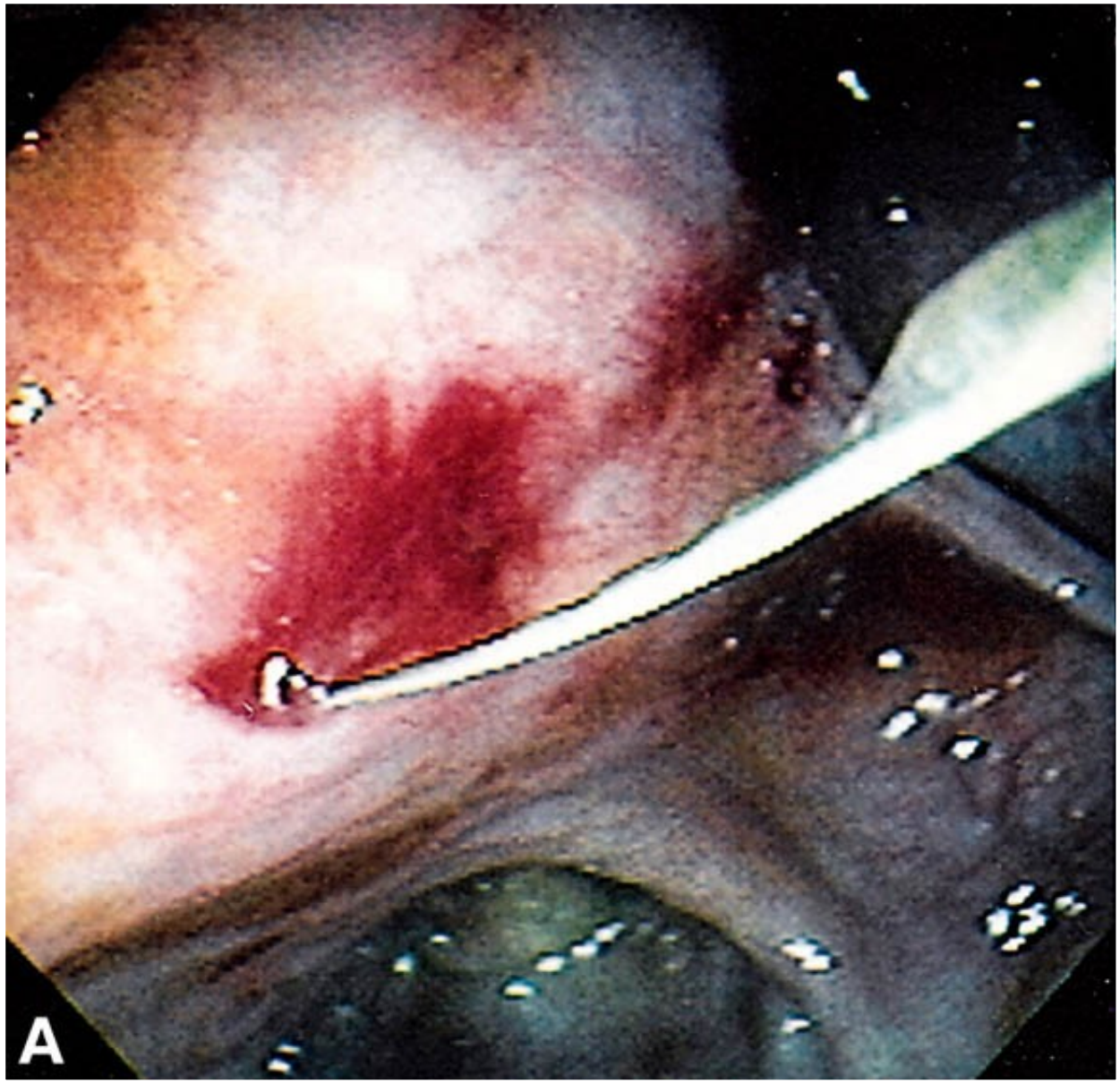
Does therapeutic endoscopy play a role in treatment of complications of diverticulitis?

Baron, et al. (*GI Endo, Jan 1997*) described success with endoscopically approached transrectal drainage of diverticular abscess tracking into pelvis using aspiration needle/catheter through therapeutic duodenoscope

Endoscopic Treatment of Diverticular Abscess



Abscess with enhancing rim



Guidewire in Abscess

Adapted from Baron, et al *GI Endo, Jan 1997*

Endoscopic Treatment of Diverticular Abscess

NB drain left in place

Adapted from Baron, et al *GI Endo, Jan 1997*

Diverticular Disease of the Colon
Prevention

Prevention

Benefit of fiber based on epidemiologic studies showing reduced fiber intake in those afflicted with diverticular disease vs those not afflicted

Prevention

- **Aldoori, et al. (1997) prospectively studied large cohort of patients over 8 yrs**
  - **Saw inverse association (RR=0.53) between intake of insoluble fiber (mainly cellulose) and development of *symptomatic* diverticular disease (pain or bleeding)**

Prevention

- **Insoluble fiber: Major constituent of fruit/vegetable fiber; not cereal fiber**
- **Cellulose: Represents 30-50% of insoluble fiber in fruit; comprises < 30% of total fiber in most other foods except legumes (50%)**

Prevention

- **Soluble fiber:**
  - **Metabolized by colonic bacteria more than insoluble fiber and therefore has minimal effect on stool weight**

Prevention

- **Surgical prevention:**
  - **Reilly performed *sigmoid myotomy* (1960's) on 85 pts: 59 with uncomplicated, symptomatic disease; 26 for pre-existing complications**
    - **71/85 had 'satisfactory' results (unspecified mean f/u time)**
  - **Procedure has not gained favor (M & M rate of 15%)**

Summary

- **Diverticular disease: very common in older consumers of “Western” diet**
- **Most asymptomatic, patients with complicated disease have non-negligible morbidity, mortality rate**

Summary

- **Disease plus complications may be preventable with incorporation of dietary insoluble fiber**
- **Endoscopy benefits treatment of complicated diverticular disease in certain situations**